JPRS 78638

30 July 1981

Worldwide Report

NUCLEAR DEVELOPMENT AND PROLIFERATION

No. 107

FBIS FOREIGN BROADCAST INFORMATION SERVICE

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service, Springfield, Virginia 22161. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semi-monthly by the National Technical Information Service, and are listed in the Monthly Catalog of U.S. Government Publications issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Indexes to this report (by keyword, author, personal names, title and series) are available from Bell & Howell, Old Mansfield Road, Wooster, Ohio 44691.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

JPRS 78638

30 July 1981

WORLDWIDE REPORT

NUCLEAR DEVELOPMENT AND PROLIFERATION

No. 107

CONTENTS

WORLDWIDE AFFAIRS

Briefs
USSR Aid to Finnish Reactor 1

ASIA

INDIA

Editorial Notes U.S. Nuclear Policy Discrepancies
(Editorial; THE STATESMAN, 29 Jun 81) 2

Briefs
Heavy Water Plant 3
Canada's Uranium Terms 3
Salt Lake Cyclotron Project 3
Desai on Bomb 3

PAKISTAN

Briefs
Enrichment Unit Moved 4

THAILAND

Briefs
Survey To Seek Uranium Ore 5

NEAR EAST AND NORTH AFRICA

SYRIA

Nuclear Capability Reported Being Sought
(Yosi Melman; HA-ARETZ, 5 Jul 81) 6

Briefs
Plans Construction of Nuclear Plant 7

SUB-SAHARAN AFRICA

GABON

Briefs
Bank Backing Uranium Mining 8

WEST EUROPE

DENMARK

Report Approves Depositing of Nuclear Waste in Salt Domes (INFORMATION, 23 Jun 81) 9

Paper Accuses Socialist Government of Delaying Nuclear Start (Editorial; BERLINGSKE AFTEN, 26 Jun 81) 11

FEDERAL REPUBLIC OF GERMANY

Nuclear Energy Essential to National Development (FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT, 25 Jun 81) 13

GREECE

Briefs
New Uranium Deposit Reported 15

ITALY

Saluggia Power Plant, Activities Described (NOTIZIARIO COMITATO NAZIONALE PER L'ENERGIA NUCLEARE, Apr 81) 16

Organization, Production of IFEC Installation (NOTIZIARIO COMITATO NAZIONALE PER L'ENERGIA NUCLEARE, Apr 81) 20

Development of EUREX Installation Traced (NOTIZIARIO COMITATO NAZIONALE PER L'ENERGIA NUCLEARE, Apr 81) 30

SWEDEN

Nuclear-Accident Protection Rules Issued (Marianne Cecilgard; DAGENS NYHETER, 1 Jul 81) 46

BRIEFS

USSR AID TO FINNISH REACTOR--Soviet and Finnish experts have started preparing drawings for a new 1 million kw nuclear power station to be built in Finland. The Soviet Union will supply a reactor to the power station. Two nuclear power stations have been built in Finland with Soviet participation. The operation of these power stations has proved the reliability and safety of Soviet technology. [Text] [Moscow in Finnish to Finland 1530 GMT 8 Jul 81 LD]

CSO: 5100/2090

EDITORIAL NOTES U.S. NUCLEAR POLICY DISCREPANCIES

Calcutta THE STATESMAN in English 29 Jun 81 p 8

[Editorial: "Agenda on Atoms"]

[Text]

Reports available in India of what Mr James Buckley, U.S. Under-Secretary of State told a Senate Committee about fuel supplies for Tarapur are not identical. According to one version, he said that U.S. and Indian officials would meet to discuss the Tarapur agreement and that its termination was "one item on the agenda". According to another, he denied that officials would meet soon and said that the "only" item on the agenda was ending the arrangement for fuel supplies. Both versions, however, quote Mr Buckley as saying that the USA might soon end its nuclear cooperation agreement with India—which means an end to supplies for Tarapur. This had been indicated earlier also, though not formally. Reports had also suggested that New Delhi itself might prefer an amicable termination of the agreement to its continuation in a manner that was more a hindrance than help. Supplies have long been uncertain and lately suspended; every time the subject has come up in recent years there has been bitter controversy, revealing aspects of the U.S. position which India has reason strongly to resent. An end to the agreement need not be viewed with alarm; nor need it cause further damage to Indo-U.S. relations—unless Washington suggests that it is being brought about by any failure on India's part to honour the provisions.

A statement of the Reagan Administration's nuclear non-proliferation policy, which Mr Buckley said would be issued "very shortly", can therefore be of only academic interest to India. Countries which have signed the nuclear Non-Proliferation Treaty and accepted related safeguards at U.S. persuasion may also wonder how the Reagan policy can strengthen the non-proliferation regime after Israel has got away with destruction of a nuclear reactor subject to safeguards and belonging to a country which is a party to the NPT. U.S. reaction cannot have enhanced international faith in the NPT; nor is Washington insisting that Pakistan verifiably abandon its bomb preparations before qualifying for massive arms supplies. In the immediate context, of course, the U.S. plan to provide Islamabad with F-16 aircraft is a much more serious development than what may be supplied in the $3 billion package or what may result from the latter's nuclear preparations. But the point to note is that Washington has chosen to ignore the long-term implications of these preparations merely on Islamabad's verbal assurance that they are not intended for weapons. In fact, Mr Buckley admitted that Pakistan had given no undertaking not to acquire a weapons option or capability. As for the suggestion that U.S. aid may be stopped if Pakistan explodes a nuclear device, this is unlikely to worry Islamabad which may get all the aid promised before it is ready for an explosion.

CSO: 5100/7119

BRIEFS

HEAVY WATER PLANT--Hyderabad, June 23--Dr H. N. Sethna, Chairman of the Atomic Energy Commission, said here today that the Central Government had cleared a proposal for setting up a heavy water plant at Manuguru in Bhadrachalam taluk of Khammam district in Andhra Pradesh. The heavy water produced by the plant would be used by various atomic reactors in the country, he told newsmen after a visit to the nuclear fuel complex here.--PTI [Text] [Madras THE HINDU in English 24 Jun 81 p 1]

CANADA'S URANIUM TERMS--Seoul, June 25 (PTI)--Mr. E. D. Lumley, Canadian minister of state for trade, said here today that Canada would not reconsider its decision to stop the supply of enriched uranium to India unless it signs the non-proliferation treaty (NPT). Mr. Lumley, who is here for a campaign to catch the billion dollar nuclear reactor bonanza in the Pacific rim area, told PTI, "Our's are the toughest nuclear standards. Canada will not relax the restriction", he added. [Text] [Bombay THE TIMES OF INDIA in English 26 Jun 81 p 1]

SALT LAKE CYCLOTRON PROJECT--The West Bengal State Electricity Board will start supplying 2.5 MW of power from Tuesday to the cyclotron project at Salt Lake in Calcutta from its 132 KV sub-station being constructed there. The sub-station, estimated to cost about Rs 2 crores, is nearing completion. Mr S. S. Verma, Power Secretary of the West Bengal Government, Mr N. C. Basu, chairman of the Board, and other senior officials visited the sub-station on Sunday morning. The Chief Minister had earlier promised Dr Raja Ramanna of the Bhaba Atomic Research Centre that uninterrupted supply of power from the Board would be arranged by the end of June this year. The DVC claimed to have generated 735 MW on Monday. A Press release said that 11 out of 13 units were operating in three stations--Bokaro, Chandrapura, and Durgapur. Two units, one in Chandrapura and the other in Durgapur, are being overhauled. The Press release said, the DVC had allowed unrestricted supply to all its consumers, including the CESC. [Text] [Calcutta THE STATESMAN in English 30 Jun 81 p 16]

DESAI ON BOMB--Kota, June 29 (PTI)--Former Prime Minister Morarji Desai has said that he was totally opposed to the manufacture of atom bomb by India even if Pakistan and whole world went for it. Replying to questions at the Indian Council of World Affairs yesterday, he said he had doubts if Pakistan would ever be able to make an atom bomb and India need not worry on that count. [Text] [New Delhi PATRIOT in English 30 Jun 81 p 8]

CSO: 5100/7122

PAKISTAN

BRIEFS

ENRICHMENT UNIT MOVED--Pakistan has secretly shifted its uranium enrichment facility from Sihala and Kahuta to Multan, according to Dr R. R. Subramaniam, an analyst at the Institute for Defence Studies and author of the book "Nuclear Pakistan". He told PTI that in order to avoid detection Pakistan has shifted the enrichment plant to Multan where a 15-tonne heavy water plant was supposed to be under construction and operational in 1980. The analyst said the shifting also made sense because of Multan's proximity to the reported nuclear test site in Cholistan desert. [Text] [New Delhi PATRIOT in English 2 Jul 81 p 1]

CSO: 5100/7121

BRIEFS

SURVEY TO SEEK URANIUM ORE--Four geologists from the International Atomic Energy Agency, IAEA, will be coming to Thailand to help search for uranium in the northeast. According to a spokesman for the Mineral Resources Department, the team will make a survey in October in Nakhon Ratchasima Province. Geological formations where uranium has been found indicated that many different areas in the northeast could have uranium. Thailand's only discovery of uranium so far was in a horseshoe-shaped rock formation covering about 5 square kilometers in Khon Kaen Province, 240 km northeast of Bangkok. The government has already announced the mining ban on all minerals in six northeastern provinces. The government is continuing surveys to determine the size of the uranium deposit already found 2 years ago, but progress is slow. Initial surveys show an interesting amount of uranium near a hill in Nakhon Ratchasima Province. The Mineral Resources Department said it is also planning to survey another site in Chiang Mai. [Text] [BK281204 Bangkok Voice of Free Asia in English 1100 GMT 27 Jun 81]

CSO: 5100/4539

NUCLEAR CAPABILITY REPORTED BEING SOUGHT

TA051051 Tel Aviv HA-ARETZ in Hebrew 5 Jul 81 p 1

[Report by London correspondent Yosi Melman]

[Text] In the assessment of Western European experts in the nuclear sciences, Syria is seeking to develop nuclear capability for military purposes. In their view, Syria's announcement that it wants to build nuclear reactors for electricity production is only a cover for its true intention of developing nuclear capability and technology for military purposes. They have warned that because of this, European countries must not supply nuclear know-how to Syria.

This reporter has learned that for almost a year now, Syria has held secret contacts with the Swiss Electrowatt Engineering Firm, and with several Belgian firms: Belgo-Nuclear, Electrobel and (Assi and Fabrikon). It should be noted that these Belgian firms are also involved in similar deals with Iraq, Algeria and Libya.

Recently, Syrian Minister of Electricity Yusuf 'Umar visited Belgium, where he held talks with the heads of these Belgian firms on the possibility of building six nuclear reactors to supply 600 megawatts of power. He also met with Belgian Minister of Foreign Commerce Robert Urbain. It has also been learned that in the wake of the Israeli attack on the Iraqi reactor, the Belgians have sought to play down their contacts with the Syrians.

Syria has signed the Nuclear Non-Proliferation Treaty, and its minister of electricity has stressed that only nuclear development for peaceful purposes is involved.

CSO: 5100/4742

SYRIA

BRIEFS

PLANS CONSTRUCTION OF NUCLEAR PLANT--Damascus--The Syrian electricity minister's assistant has declared that the ministry's plan includes the construction of a nuclear plant in Syria, to be ready at the outset of the 1990's considering that about 10 years are needed for studying and implementing this plan. It is expected that the Syrian Electricity Ministry will sign a contract with a foreign consultant office at the outset of next month for this purpose. [Text] [JN151525 (Clandestine) Voice of Palestine in Arabic 1505 GMT 15 Jun 81]

CSO: 5100/4741

BRIEFS

BANK BACKING URANIUM MINING--Paris, 13 Jul (AFP)--The European Investment Bank has loaned Gabon some 2.2 million dollars to develop the production of uranium and hydroelectricity, the bank said today. The Franceville Uranium Mining Company will receive 1.5 million dollars to modernise a uranium treatment plant and extend the mine and related facilities in the east of the country. The result is expected to be the creation of some 400 jobs and a rise in production capacity from 1,000 to 1,500 tons of uranium a year, bringing extra foreign currency to Gabon. The remainder of the loan will be used to bring a nearby hydroelectric plant up to 35.2 megawatt capacity to supply the uranium mines and surrounding area by 1983. [Text] [NC131238 Paris AFP in English 1224 GMT 13 Jul 81]

CSO: 5100/2090

REPORT APPROVES DEPOSITING OF NUCLEAR WASTE IN SALT DOMES

Copenhagen INFORMATION in Danish 23 Jun 81 p 5

> [Text] There is "extremely little likelihood" that accidents might occur in connection with storing highly radioactive waste in salt domes in Jutland according to the Elsam and Elkraft electric companies.

On Monday the electric companies Elsam and Elkraft reported to the Environmental Affairs Ministry and the Energy Ministry that radioactive waste from Danish atomic power plants could be placed safely in the salt domes in western Jutland. This announcement was made in connection with the delivery of the report prepared by the electric plants at the request of the government. According to the electric companies it contains the documentation "that is needed for the authorities to be able to evaluate whether there are Danish salt domes suited to the safe storage of highly active waste."

The report will now be evaluated by the authorities, who for this purpose have reached an agreement with a number of institutions, including Danish Technical College institutes which are headed by scientists who even before the investigation began expressed conviction that such storage can be undertaken quite safely.

The electric plants began the first phase of their investigation 4 years ago. In the past 2 years the practical drilling and measurements "in the field" were carried out which, for example, the Hessner committee in 1976 estimated would take at least 10 years to provide reliable information. Along the way the electric plants have been sharply criticized by local inhabitants for the way they have worked in West Jutland while experts in the field have spoken out against the numerous positive conclusions the electric plants have "leaked" before the investigations officially came to an end.

In a press release Monday Elsam revealed that the electric plants only coordinated and organized the work "while Danish and foreign experts in the field carried out most of the work and prepared the interim reports." Elsam claimed that assistance had been obtained from 20-25 institutes and firms in five countries.

The waste report itself is in five volumes with the following titles: "Summary," "Geology," "Material Tests," "Storage Facilities" and "Safety Statement."

It appears from the volume "Summary," which was issued Monday, that the electric plants believe the salt domes in Mors fulfill the safety requirements.

Conclusion

In the section, "Safety Statement," the conclusion ends like this:

"Both field measurements and laboratory research showed that the chalk strata over the dome in the vicinity of the proposed storage area are very compact. It has also been shown that chalk binds radioactive substances, especially the long-lived actinides, very effectively even in the presence of high concentrations of sodium chloride. The safety calculations of these conditions show that the waste hardly moves from the place it escapes, in the event, against expectations in a hypothetical situation it should leak from the dome to the watery chalk layer. This means the radioactive substances will decay in the deep chalk layer and therefore cannot emerge in fresh-water areas.

"The results of the investigations show that the limestone strata referred to constitute an effective secondary barrier that will prevent radioactive substances from reaching the biosphere from the underlying storage area. It has also been shown that they provide considerable protection against the dissolution process of the surface of the dome stemming from the waterlogged strata above the dome. Calculations based on data pertaining to the distribution of salt concentrations in the limestone strata also show that this protection has functioned for millions of years.

"Besides the safety calculations referred to concerning the effects of the abovementioned natural processes in the storage area studies were made of two hypothetical events, namely the occurrence of water-permeable faults in the limestone strata above the salt dome and an active tectonic fracture zone in the bottom strata underneath the dome. Calculations showed that even under these conditions the steel containers could not be broken down in such a way as to lead to release of the waste substances.

"In this connection studies were also made concerning possible human penetration of the dome, for instance exploratory drilling or cavern flushing. Such events would presume the loss of all knowledge concerning the presence of the storage deposits. In addition the dome would have to be chosen in preference to many others that are situated higher and are more easily accessible. Finally the drilling or flushing operation would have to hit very precisely to come in contact with the deposits.

"The likelihood that any of these events would occur is extremely small. Even so calculations were made of the effects of such events based on a pure assumption of their occurrence. The calculations showed that the compacting of the rock salt would halt the breakdown of the steel containers before there was a chance of leaking from the glass. If one also assumes that the steel containers are ineffective in this situation radioactive waste could leak into the limestone area above the dome. But the radioactive isotopes would be delayed so much that they would decay to insignificant amounts before eventually reaching fresh water. Here there would be so much dilution that radioactive concentration would lie many times below previous levels due to natural radioactive content," the electric plants said.

6578
CSO: 5100/2285

PAPER ACCUSES SOCIALIST GOVERNMENT OF DELAYING NUCLEAR START

Copenhagen BERLINGSKE AFTEN in Danish 26 Jun 81 p 8

[Editorial]

[Text] In the Marienborg declaration of the SV [Social Democratic-Liberal] government on 30 August 1978 Point 14 stated: "The use of nuclear power is part of the government's energy policy. Studies on the placement of highly radioactive waste are being conducted. The government expects that within 2 years there will be clarity as to the possibilities for reasonably safe placement of highly radioactive wastes."

In the government's opening statement in October of the same year it said that it was "necessary to use nuclear power as part of our energy supplies assuming that operational safety is adequate and that a satisfactory solution is found to the waste problem."

On 21 August the year after that the government reiterated the necessity of using nuclear power and said at the same time: "The government finds it appropriate to submit a bill approved by Folketing granting permission to install nuclear power plants to the people in a referendum." The same statement instructed the chairmanship of the Economic Council to prepare a report within 8 months to clarify the consequences of a Danish energy policy without nuclear power.

In this report which came out in June 1980 the chairmanship concluded that a shift to coal, nuclear power and natural gas would lead to an increase in supply certainty but otherwise pointed out that the most important factors that should be used as a basis for a decision were profitability, supply certainty, price certainty and environmental and risk elements.

But by then Energy Minister Poul Nielson had said at a meeting in Copenhagen that the government had now decided on an energy policy line calling for "realistic and concrete plans for a future without nuclear power."

Now the Danish electric plants have delivered a study which they claim documents that salt domes in Jutland are safe storage places for highly-active waste from Danish atomic power plants. The investigation cost 80 million kroner and was financed through the price of electricity. These studies will now be supplemented with others which will also cost millions. When these studies are concluded they will be supplemented by more studies looking into safety and transportation problems in connection with the daily operation of nuclear plants. That won't be done for free either

In the meantime the voters are becoming more and more confused. And that is the idea.

The Social Democrats don't dare introduce atomic power into Denmark. Therefore energy consumption must be limited and supply reserves of oil, coal and gas must be as multifaceted as possible. Oil extraction in the North Sea must be intensified and North Sea gas must be brought into use, coal must be bought from South Africa and Energy Minister Poul Nielson must travel to Saudi Arabia and promise not to discredit that miserable rocky land's medieval rule. In the next few years an army of energy consultants will decide the extent and manner of insulating single- and multi-family homes and meeting the requirements set will be a condition for issuing an energy certificate. Just some examples of the price to be paid for a Denmark without nuclear power.

6578
CSO: 5100/2285

NUCLEAR ENERGY ESSENTIAL TO NATIONAL DEVELOPMENT

Frankfurt FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 25 Jun 81 p 7

[Article by TN: "Expansion of Nuclear Energy Is Indispensable; Nuclear Energy in the New Federal Government Energy Program"]

[Text] Frankfurt, 24 June--Within the Federal Government work on the text of "Extension of the Energy Program" is going ahead. The final version can be expected in the third quarter of 1981. The various ministries of the Federal Government have taken different positions in particular on the utilization of nuclear energy, characterized specifically by the attitude of the Ministries of Economics and the Interior. The Federal Ministry of Economics is trying to steal a march on the somewhat negative position of the Federal Ministry of the Interior through well-aimed indiscretions about the intentions of the Federal Government regarding the utilization of nuclear energy. A few preliminary drafts on the treatment of nuclear energy in the extension of the energy program have become known in Bonn. According to these drafts by the Federal Economics Ministry for the extension of the energy program, the following facts emerge in the nuclear energy policy of the Federal Government:

At this time 10 commercial nuclear power plants (and 4 additional nuclear research reactors) with a total of 8,950 megawatts are in operation. Nuclear energy contributed 11.5 percent of the total power production in 1980. An additional 8 large nuclear power plants with 10,600 megawatts are under construction. Add to this the fast breeder research reactors in Kalkar and the high temperature reactor in Schmehausen with a total of 635 megawatts.

By 1985, 18,200 megawatts of nuclear power are to be produced by operating plants, and 20 percent of the electrical power demand of the FRG would then be met by nuclear energy. Upon completion of the other nuclear power plants which are in the process of being licensed, after 1990 only 25,000 megawatts would be in operation, in the opinion of the Ministry of Economics.

Expansion of nuclear energy in the FRG is pictured as indispensable by the Federal Government, motivated by the dependence on oil and recently by the balance of payments. However, in the third extension of the energy program as well the limitation of the expansion will be based on the restrictions of the second extension of the energy program.

1) Priority for saving of German coal. 2) Further expansion only when the safety of the nuclear power plants has been guaranteed in order to protect the population. 3) Satisfactory waste disposal provisions.

In the international area the Federal Government has unequivocally committed itself to increased nuclear energy utilization. This was demonstrated at the economic summit meetings in London, Bonn, Tokyo and Venice, by the results of the International [Nuclear] Fuel Cycle Evaluation Conference and by increased nuclear energy expansion in Western and Eastern nations as well as in Argentina, Brazil and South Korea.

There has recently been talk about "expansion geared to demand." What this means in detail is subject to dispute between the Federal Government and the Laender and within the Federal Government itself. If one assumes that power plants fueled by natural gas are to be converted or shut down, the result will be greater demand for nuclear energy utilization than in the case of retention of the present power plant structure. If there is to be increasing processing of brown coal, more nuclear power must be built in order to free up brown coal for refining. Against this so-called "need" there is considerable resistance within the Federal Government, above all from the SPD.

The Ministry of Economics represents the opinion that for base-load power nuclear power plants show a considerable cost advantage compared to power production from hard coal. All the costs of waste disposal and decommissioning of nuclear power plants have been included in this consideration. Other ministries, in particular the Research Ministry, through their political representatives, plead for the use of coal in the base-load area and for taking the cost disadvantages into the bargain.

The safety of the German nuclear power plants is judged favorably by the Federal Ministry of Economics. Waste disposal for the nuclear power plants is seen as guaranteed and takes place in the framework of the plan which was established by the heads of government of the Federation and the Laender. No problems are anticipated in the uranium supply. The suppliers of natural uranium until 1990 will be (in percent): Australia (38), South Africa (32), Canada (11), Southwest Africa (8), Niger and Gabon (7) and the United States (4). Presently, 55 percent of the uranium enrichment takes place in the Soviet Union and 45 percent in the United States. Construction of the German enrichment plant in Gronau will soon begin. In 1985 34 percent of the German need will be met, according to the present plans, in connection with the German-Dutch-British cooperation in the area of uranium enrichment.

11949
CSO: 5100/2282

BRIEFS

NEW URANIUM DEPOSIT REPORTED--A new, large deposit of uranium has been located at the "Arkoudhorema" site in Drama, a short distance from the known deposit at the Paranestior site. According to the first indications, this is a very considerable deposit estimated at hundreds of tons. An announcement to this effect has been made by the Institute of Geological and Mineral Research. [Text] [NC192305 Athens Domestic Service in Greek 2100 GMT 19 Jul 81]

CSO: 5100/2090

SALUGGIA POWER PLANT, ACTIVITIES DESCRIBED

Rome NOTIZIARIO COMITATO NAZIONALE PER L'ENERGIA NUCLEARE in Italian Apr 81 p 21-23

[Text] The Saluggia power plant was built with the intention of pursuing applied research on the pilot plant scale in the fuel cycle field.

Operations began in 1963 with the establishment of the fuel element manufacturing and control laboratory.

The goal which the CNEN [National Nuclear Energy Commission] pursued with that initiative was, within a reasonably short time, to have an efficient instrument capable of developing, on a pilot scale, the technologies connected with the manufacture of fuel elements and, secondly, to go into production. This production effort was above all to be concentrated on support for the CNEN program and it was hence quantitatively limited to small series; the most that could be contemplated in this connection, as a production effort for a technological research and development laboratory, was the manufacture of a limited number of prototype reactor nuclei [cores].

There was another objective of major significance behind this initiative and that was to launch an effort at industrial promotion in the field of fuel manufacturing, taking into account the fact that three first-generation nuclear power plants (Trino Vercellese, Garigliano and Latina) had become operational at that time and it seemed certain that others would go into operation shortly.

We can easily understand therefore that the CNEN did not fail to realize the need for engaging in this promotion effort in an area where two among the Italian industrial establishments most heavily committed to the nuclear sector--Fiat and Montecatini--had already created a research center equipped with high-grade technological resources and installations.

We are specifically here talking about the Saluggia Nuclear Power Plant of SORIN (Nuclear Research and Facilities Company), at that time made up equally of the two above-mentioned industrial establishments. It was clear that the characteristics of this setup, as a whole, constituted and still constitute a situation which is good from the logistic viewpoint and which is difficult to repeat regarding the management of development activities connected with the fuel cycle. The location of that facility, sufficiently close to the biggest industrial centers and sufficiently far from major population concentrations, as well as the prior existence of huge specialized port facilities at the SORIN power plant, and the vast availability of energy and water were other helpful factors. These advantages made up for other shortcomings, such as the efficiency in public transportation, the difficult weather conditions, and the fact that the area was not suitable for settlement.

And we recall, the first unit installed at Saluggia was the fuel element manufacturing laboratory which was set up in a leased building at the SORIN power plant. While this first unit kept growing and increased in terms of equipment and personnel, the EUREX program developed parallel to it; it was designed in a short time to prepare the blueprints, to acomplish the construction and to start the operation of a pilot plant for the development of fuel reprocessing; it seemed a natural thing to put that facility there; a piece of land contiguous to the SORIN area was picked and CNEN acquired it for itself.

The industrial development and promotion program started by the CNEN at the time these two operational units were set up (in effect, the 3-year period of 1963-1966), afterward experienced a slowdown on account of some very complicated technical and political reasons; but this did not mean that the selection of the place and the program's thrust were wrong. On the contrary, the development of the situation showed that a continuation of the agency's promotion effort was indispensable provided there was a boost in the entire effort, involving the creation of bigger demonstration equipment for the industrial processes connected with the manufacturing, regeneration, and recycling of nuclear fuels.

This boost did as a matter of fact materialize during the years thereafter, on the one hand, with the conversion of the manufacturing laboratory into the IFEC (Fuel Element Manufacturing Plant) consisting of three element production lines for reactors of the MTR type which were proven and quite advanced, and, on the other hand, with the establishment of the EUREX plant which was enabled to reprocess, in addition to fuel elements for MTR reactors, also and above all fuel elements for heavy-water reactors and, in the future, light-water reactors. Besides, since the size assumed by the IFEC plant was not compatible with the uncertain lease contract, the CNEN purchased the building that housed the plant and the surrounding land.

In this way, the Saluggia power plant was enabled to supply the country with this industrial promotion effort in two fundamental areas of the fuel cycle which institutionally were assigned to the CNEN.

The rather well-known political vicissitudes which did not make it possible to extend to a nationwide scale the decisions that should have been made in terms of energy planning and to launch the national energy plan, prevented the operations of the Saluggia power plant from being used quite logically by domestic industries; in particular, this did not permit the establishment of those companies, among the ENI [National Hydrocarbons Agency], the ENEL [National Electric Power Agency], and the CNEN for the management of the various phases of the fuel cycle, which the 23 December 1977 resolution of the CIPE [Interministerial Committee for Economic Planning] had pointed out as the instrument necessary for the implementation of the plan itself. However, realizing that the decision on the development of energy sources could no longer be further postponed and that such decisions would necessarily have to take into account the irreplaceable although not exclusive role of nuclear energy, the CNEN did not fail to make every effort--overcoming by no means minor difficulties due to the uncertainties on the political scene--to turn the Saluggia power plant into an effective research and industrial promotion effort and a valuable source of resources in terms of knowledge, equipment, and personnel in the service of the country.

Finally, in keeping with the political guidelines which tend to extend the activities of the agency toward technological research in the sector of alternate sources and energy savings, the CNEN at the Saluggia power plant started and intends to develop some activities in line with its geographic location, such as checking the efficiency of passive solar systems for existing buildings, energy consumption studies and rationalization tests, collaboration with local agencies in heating projects for urban centers, collaboration with Confindustria [General Confederation of Italian Industry] as part of an effort to provide consultant services for small and medium industrial establishments in the energy savings sector.

Description of Power Plant

The Saluggia power plant was established by the CNEN in 1963 (Figure 1).

The Saluggia area, involving a small town in the province of Vercelli, located about 100 km from Milan and about 40 km from Turin, was picked because of its closeness to these two major industrial centers and at the same time because of its distance from major urban areas. Another reason of no less importance in picking the site was the presence of SORIN at Saluggia.

This company, which is currently engaged in industrial activities in the field of medical applications of radioisotopes and more generally in the field of biomedical engineering, in 1963 was engaged in intensive nuclear research activities and was already able to make vast specialized support facilities available to CNEN--facilities which had been planned to accommodate nuclear research activities.

The selection of Saluggia as the site of nuclear activities was further confirmed by the subsequent establishment of the COREN company of the ENI group, a licensee of Westinghouse, operating in the fields of fuel element manufacture for PWR.

The activities performed by the CNEN at the Saluggia power plant involve two basic fuel cycle sectors, that is, the manufacture of fuel elements and their reprocessing after the discharge of the reactor.

Research and development activities concerning manufacturing technologies are going on in the IFEC plant which the CNEN set up in 1963 near SORIN in a building which the CNEN acquired in 1980.

Thereafter, on a piece of land which it owned adjacent to the SORIN site, the CNEN built a plant called EUREX, destined for experimentation on a semi-industrial pilot scale for irradiated fuel reprocessing methods and related final treatment processes for liquid radioactive waste deriving from reprocessing.

The IFEC plants and EUREX are operating under the fuel cycle department of the CNEN with a personnel force of about 100 persons per plant and with an organizational structure that gives the plants themselves extensive technical-operational autonomy.

This organizational structure has four organic units under the plant management, specifically, the plant operations service, the assistance and control service, the technical plant service, and the operational physical health service.

In support of the research activities of the CNEN plants, we have the following common services, under an operating directorate at the power plant: administration, personnel, general services, library, radiation protection, and labor medicine.

Of particular importance to the activities of the plant is the function performed by the radiation protection and labor medicine service which has the job of carrying out environmental radioactivity monitoring, whole-body radioactivity measurements, radiation toxicology analyses on biological samples, special analysis measurements on radioactive samples of waste discharged by the plants.

This service furthermore provides medical surveillance for protection, employing the services of an authorized physician. The power plant's operations management section also has the job of coordinating the organization of the external emergency plan which has been drawn up to cope with any possible nuclear incident that might cause radioactivity to be released outside the power plant.

Finally, the operations management section is in charge of activities in the field of alternate sources and energy savings which began in 1980 both in the form of specific projects on the spot and in the form of participation in projects which other CNEN power plants are working on.

These activities are destined to grow with particular reference to possible application in northern Italy where the Saluggia power plant is located.

PHOTO CAPTIONS

Figure. Aerial view of Saluggia power plant.

5058
CSO:8128/1331-A

ORGANIZATION, PRODUCTION OF IFEC INSTALLATION

Rome NOTIZIARIO COMITATO NAZIONALE PER L'ENERGIA NUCLEARE in Italian Apr 81 pp 24-41

[Text] The IFEC (Fuel Element Manufacturing Plant) is located in the SORIN compound, in a building and on land surrounding the CNEN [National Nuclear Energy Commission] property. The useful surface is about 6,650 m^2.

The manufacturing plant is organized in three production lines--one metal and two ceramics--each of which, by law, is a nuclear plant (DPR [Presidential Decree] 185, dated 13 February 1964). The three production lines are independent of each other and separate from each other, not only in terms of their location in the building but also regarding the flow of materials from the fissile materials warehouses to the finished element warehouses.

The metal or MTR line starts with metallic uranium which is highly enriched (up to 93 percent in terms of U^{235}) and which can produce elements of the MTR type in small series both in plate and in tube form. (The output capacity is on the order of 200 elements per year.) The production line comprises all processing phases, from fusion and alloy preparation, to their plastic and mechanical processing and on to quality control for the various phases.

The enriched UO_2 ceramics line can process materials containing uranium oxygen with enrichment from 1 percent to 90 percent in terms of U^{235}; these processing operations require special caution in terms of operational procedures and involve limitations in terms of the quantities processed and, hence, in the line's output capacity. The standard output capacity of this line is 10 t/yr of UO_2, enriched up to 5 percent. For enrichment between 5 and 50 percent, the capacity depends greatly on the geometry of the bars to be manufactured. By way of example, with a fast geometry of the PEC [Fuel Element Testing] type, the standard capacity is 2 t/yr.

Finally, the natural UO_2 ceramics line (in practice, up to 1.5 percent enrichment) has an output capacity of 25 t/yr of fuel elements for heavy-water reactors. This production line was specifically designed for the development of fuel element technologies and manufacture to be used in turning out the first nuclei [cores] of the CIRENE prototype reactor.

Production Lines

The IFEC began operations with the MTR metal line coming from the production of the third recharge of the Avogadro reactor of SORIN which on that occasion increased its capacity to 7 Mw; it was continued during the following years as a routine activity which is by now quite standardized. As of now, a total of 237 fuel elements has been manufactured and shipped, broken down as follows:

97 for the SORIN Avogadro reactor,
100 for the Galilei reactor of CAMEN [Center for Military Applications of Nuclear energy],
40 for the RB-2 reactor (in the form of thin sheets).

The total content of uranium, enriched to 90 percent, contained in them, was about 40 kg. All of these elements were used in the respective reactors; their metallurgical lifetime always turned out to be longer than the neutron lifetime; the average combustion rate was 22-24 percent.

In recent years, the plant's MTR section has undergone installation modifications designed to increase its functional efficiency and safety.

The section consists of four subsections:

Fusion subsection, where the uranium-aluminum alloy is prepared through vacuum fusion;

Laminating subsection, where the fissile nuclei of the thin sheets are taken out of the fusion ingot, coated with aluminum, and first laminated hot and then cold;

Assembly subsection, where the fissile sheets are first subjected to finishing operations and are then assembled with the element's structural parts (shoulders, legs, and head);

"On-line" quality control subsection, where visual controls, dimensional checks on components and on the finished element, as well as fluoroscope inspections to reveal the positioning of the fissile nucleus inside each thin sheet, plus surface contamination checks, etc., are performed.

Figure 2 shows a detail of the furnace in which the uranium-aluminum alloy is melted. Figure 3. shows a group of finished elements.

The moment the project and the installation of the MTR line had been started, the program was continued with the project for the enriched UO_2 ceramics line, following the completion of the production of fissile bars of the light-water or heavy-water thermal reactor type, using uranium oxide and mixed oxide of thorium and uranium as fissile material and zircalloy and inoxydable steel as sheathing material; as for assembly, the line was originally intended for making BWR elements of the Elk-River type (PCUT) and elements of the CIRENE type.

The project was carried on the basis and in the light of the results of an impressive research and development effort which had made it possible to come up with reliable, economical, and in some cases original reproducible methods for the accomplishment of the various phases of the manufacturing process. The fundamental points on which the research and development effort was concentrated involve the preparation of the pellets and the preparation of the bars (see the following paragraph).

The planned line was installed in 1966 and tested with nonenriched fissile material; the test involed two different runs, with the first one using elements of the uranium-oxide type, sheathed in zircalloy, while the second one involved elements with mixed oxide of thorium and uranium, sheathed in inoxydable steel. These two test runs were not an end in themselves but were designed within the context of the CIRENE program and the PCUT [Uranium-Thorium Cycle Program].

In the case of the former, 30 different CIRENE bundles were made for a total of 1,000 kg of natural UO_2 pellets, contained in about 600 small bars of zircalloy. In the second test run, 20 elements of the Elk-River type were manufactured for a total of 700 kg of extruded and sintered bodies of mixed oxide of thorium and uranium (2.20 percent U), contained in 500 bars of inoxydable steel.

After these tests had been performed, the line was placed in operation with enriched fissile material; so far, about 5 t with varying degrees of enrichment have been processed here. In particular, the following have been manufactured:

For the CIRENE program, about 50 elements and testing sections with enrichment between 2 and 4 percent;

For the Naval Propulsion Program, 2,208 bars containing 1,900 kg of UO_2 pellets enriched to 4.70 percent;

For the thorium cycle program, 114 bars of zircalloy containing extruded bodies of ThO_2-UO_2 (2.2 percent of U^{235}), irradiated in the Halden reactor;

455 bars of aluminum containing pellets of ThO_2-UO_2 (2.4 percent U^{235}) for physics experiments in the ECO reactor;

Three PWR type elements (length 1 m) with natural UO_2 for IAEC supply (Iraq) for a total of 600 kg of sintered UO_2 pellets (Figure 4);

1,000 kg of sintered pellets of depleted UO_2 (EPEC VI geometry).

The line, which recently has been completed and improved in terms of its facilities, consists of four subsections:

The pellet manufacturing subsection where operations are performed involving the granulation powder precompacting, final pressing, sintering, and rectification; the subsection is among other things equipped with two presses (a double-action mechanical press capable of 1,500 strokes per hour) and four sintering furnaces, including two continuing ones;

Bar manufacturing subsection, where the bars are filled with fissile material, followed by the welding of the terminals, pickling and surface treatment; the subsection among other things is equipped with two alternated TIG welding machines; besides, there is equipment for pickling and passivation of zircalloy components, comprising an autoclave having useful dimensions of 240 mm diameter and 3.5 m height; the maximum operating conditions are 220 atm abs and 400° C;

Assembly subsection, where the mechanical processing is done to finish the structural components and the bars, plus the assembly operations as such;

On-line quality control subsection, where all visual, dimensional, density, tightness ("leak detection"), surface contamination of finished bars, etc., tests are performed.

Finally, the third line, the ceramics line with natural UO_2, was designed between 1969 and 1970 on the basis of lessons learned during the operation of the enriched UO_2 line, on the basis of specific technological research work done within the context of the CIRENE element development effort and in the light of the project requirements as such.

The line was planned for a capacity of three CIRENE bundles per day, corresponding to 100 kg of UO_2-pellets. The equipment as such was completed in 1971 and its installation was begun.

Similar to the enriched UO_2 line, the CIRENE line comprises the subsections for pellet manufacture, bar manufacture, assembly, and on-line quality control. It however also has a fifth subsection, equipped with a specialized laboratory for the application of small spacing plates upon sheaths, an operation which is performed by means of brazing with beryllium. Compared to the enriched UO_2 line, the CIRENE line is provided with more modern and higher-capacity equipment. Among the most important items we might mention two simulated double-action mechanical presses (one with 15 t for precompacting and another one with 50 t for final pressing), each capable of rates of more than 2,000 strokes per hour (Figure 4); a continuous sintering furnace with four independent zones (Figures 5 and 6); two rectifiers equipped with devices for the restoration of the intervals between the molds; a welding machine for bar terminals of the resistance type (MFW) (Figure 7); a complex for drying the pellets (up to a residual humidity content of less than 5 ppm), remote introduction into the sheath, and welding with TIG (arc welding by means of tungsten electrode in inert gas) of terminals, equipped with a system for the control of positioning and reproduction of welding parameters through electronic computer with punched cards (Figure 8). Finally we might mention particularly sophisticated equipment for finishing the bars with simultaneous profile turning of plugs (Figure 9) for assembly (Figure 10), and for the dimensional check on the bundles [beams] (Figure 11). The beryllium laboratory was established for safety reasons in an area far from the line. The actions undertaken for the pertinent project and installation, staying within the regulations applicable in this respect as well as the strict operator protection criteria, are described elsewhere. The procedures adopted will be outlined below:

First we have the metallization of the zircalloy sheets with metallic beryllium through vacuum evaporation (Figure 12);

After checking on the thickness of the deposited beryllium, the spacers are cut off the small metal plate;

The spacers are then positioned on the sheets by means of resistance micropuncture and they are then brazed for heating under vacuum induction (Figure 13).

The CIRENE line was tested by means of nuclear tests and, at the rate of three bundles [beams] per day produced a preliminary series of 120 elements. From the experiments during the preliminary series, we obtained the information necessary for planning the production of the first charge for the CIRENE prototype reactor.

Along with the operations of the three production lines, we have, on the same level of significance, the operations of the technical service (maintenance, equipment planning, workshop, etc.), the physical health service, and finally the inspection service. Control activities in particular are aimed at the following:

Performing all "non-on-line" analyses (chemical-physical, metallographic), required according to the acceptance specifications for the materials and the manufacturing procedures;

Checking on the quality of products turned out through inspection and supervision of "on-line" controls carried out directly by the plants.

The first activities, which are those that prevail and that involve research and development on quality control methods, are organized in the following manner.

Chemical Controls

Here we have two sections:

Analytical, which is responsible for performing all chemical controls on incoming materials (fissile and nonfissile) as well as semifinished products;

Chemical-physical, which is responsible for the determination of the magnitudes connected with the surface state on the ceramic bodies;

Mechanical-Metallurgical Controls

Here we have three sections: metallography, performing the metallographic controls required by the manufacturing plants and by research and development activities;

Materials testing, comprising all tests (mechanical tests, roughness, heat treatment, corrosion, etc.) designed to characterize the various materials from the metallurgical viewpoint;

Nondestructive testing, comprising ultrasound controls and x-ray controls.

Figures 14-16 illustrate some of the equipment used.

Safety and Protection

Regarding plant safety and health protection for personnel, without going into any details on the operating regulations, deriving from legal standards, we might illustrate the effects of the safety and protection system to which particular attention is devoted.

All processing operations which entail the danger of operator contamination and dissemination of dust into the environment were designed to glove-chambers of the traditional type or they were made "ad hoc" on the individual machinery and equipment, keeping them in a constant state of depression as compared to the working environment. Where this is technically not possible, high-speed entry locks were installed, along with other special devices.

The general facilities of the building in which the plant operates were modified and boosted in the light of these discoveries. Ventilation is provided by three plants performing the following functions:

Injection of outside air, after filtration and thermohygrometric treatment, with a range on the order of 77,000 m^3/hr

Aspiration of air from premises and its expulsion through the chimney (70 m) with open circuit (no recycling) to a sufficient degree so as to assure a minimum of six changes per hour in fissile material processing areas;

A second, completely separate and independent aspiration plant takes in air from the "hot" locks [hoods] and from the glove-boxes and is supposed to maintain the required depression there (10-20 mm Hg). The air taken in is then moved to the chimney after absolute filtration.

The risks due to the presence of hydrogen in the sintering furnaces are prevented by continuous environmental air analyzers arranged at various points in the rooms in which they are installed; these analyzers are set to sound the alarm for hydrogen concentrations equal to 12.5 percent of the lower explosiveness limits. Other devices authomatically interrupt the flow of hydrogen from the little power supply station if there are any abnormalities in the capacity (for example, due to rupture of a conductor [pipe]). Any possible critical incidents are prevented by procedures and controls adopted for the movements and processing operations involving fissile materials; they are in any case reported by a gamma detector system which automatically sounds a general alarm in less than 300 msec when the radiation level sets off more than one sector. The threshold is 15 mR/hr, considering the fact that the exposure in the laboratories is never more than 1-2 mR/hr.

Completely separated ventilation plants were installed for the "beryllium laboratory" which, in the absence of Italian legislative standards and comparable prior data, was executed with particular reference to the standards and specifications of the Canadian plant of CGE Ltd of Peterborough.

An autonomous, open-circuit plant provides, in those rooms, a rather high number of hourly [air] changes (up to 15 in the most exposed rooms) and a depression, compared to the outside environment, which varies from the 5 mm H_2O of the laboratory entrance release (all doors are air-tight) to the 20 mm of rooms deep inside and most exposed. The extracted air is filtered with absolute filters. Special devices were installed to guarantee a minimum of exchange in any situation and above all to provide a depression in the rooms.

All of the processing operations are performed in glove boxes or with localized aspiration. The toxicity limit considered is 2 gamma of beryllium per cubic meter of air during 8 hours of work and for its control, as for the surface contamination controls, detection and analysis systems were devised with the necessary sensitivity.

Process Development Activities in Support of Projects (Up to 1980)

The areas in which most work was done were those that pertain to the perfection of the ceramics process and the processes involved in the link between metals and the assembly.

The perfection of the ceramic process required a particularly difficult effort which took into account the characteristics of the original UO_2 powder, the project specifications for the pellets, the manufacturing step, the relative cost, the reproducibility of the procedure, etc. We arrived at the current satisfactory result also by doing original work.

We must particularly emphasize the problem of pellet quality control. A quality control process was worked out and calibrated through sampling, adopting the data and criteria spelled out in the standard MIL-STD-414 "Sampling Procedures and Tables for Inspection by Variables."

A similar effort in terms of commitment and scope was devoted to the bar assembly procedure. In this field, the welding connection between the plug and the sheath assumes particular importance.

Three welding procedures were worked out; the first one was based on the TIG method, using helium; the second one was based on the MPW (percussion welding) method, and the third one was based on the electrical impulse method (Magnetic Soudage [welding])

In the first case (TIG), during the development phase, we determined the influence of the variation in the welding parameters (current, rotation speed, gas pressure in chambers) and the projection parameters (thickness of pipe, design of plug) on the seal, on the penetration of the welding, and on the dimension of the grain. Another significant parameter is the type of connection between the pipe and the plug (slack, precise, interfering), and all of these cases together.

The controls performed during the development phase thus were destructive (metallography) and nondestructive ("leak detection" and "x-ray").

After development and reproducibility tests, we established the control criteria which are as follows:

Leak detection: 100 percent,
X-ray: 100 percent,

Metallography, one out of 25 weldings through preparation of a sample taken from a pipe section.

The experience gained in scores of thousands of weldings made it possible to come up with the following reject percentages:

3 percent for mistakes in the connection between the plug and the sheath;
0.1 percent due to defective fields in the leak test;
1 percent due to individual porosity in excess of 150 ppm, determined through x-ray.

In the second case likewise (MFW) we determined the effect of the particular parameters of the process on the quality of the welding; in this case, the area concerned is not involved in fusion but only in softening with local deformation; the examination of the junction is even more important both regarding the mechanical aspects and the gas-tightness aspect.

Regarding the welding called "Magnetic Soudage"--given the novelty of the procedure, we consider it advisable to present a brief description.

The peculiar characteristic of Magnetic Soudage is that we perform a practically cold welding between the plug and the sheath, hence, without causing any changes in the structure of the material. A considerable quantity of energy (up to 1 kl), accumulated during the charge phase, in a high-voltage condenser bank, is discharged instantaneously into an induction coil arranged around the zone to be welded. The (Faraday) currents induced in a metal propulsor, inserted between the coil and the sheath, bring about a repressive action among the components which is why the coil, pushed toward the outside, explodes, while the propulsor, pushed toward the inside, violently deforms the sheath upon the plug, performing its welding over the entire circumference. The qualification tests performed on this new type of welding (leak test, ultrasound, "peeling" tests, bursting tests, and metallographic examinations) revealed good resistance and reproducibility characteristics.

These are only some of the development problems encountered and solved over the years; we could continue by mentioning those pertaining to the assembly of the bundles [beams], the check on the content of hydrogen and water inside the bars, the check on corrosion relative to the zircalloy sheaths, the recovery of waste from sintering, sintering without rectification, etc.

We furthermore under took all actions necessary and we started the procedures for performing all kinds of processing on the basis of quality guarantee.

Regarding finally activities performed in the past we might mention the work devoted to the development of the CIRENE element.

Some of the characteristic aspects of the CIRENE element were identified in close conjunction with the work done by the designers; that included the calculation of the pressure of the fission gas inside the bar, the field of stresses and deformations induced in the terminal plate during operation and interaction under irradiation of the uranium oxide pellets with the sheath. This above all required analytical calculation, developed by the designers, but along with that activity we obviously also had to develop experimentation by setting up some "ad hoc" programs. This was followed by the entire complex of process qualifications and control procedures which were gradually checked out with the help of irradiation in testing sessions or real-life CIRENE bundles.

The phenomenon of interaction between the pellets and the sheaths in particular was a factor which reduced the output of the CIRENE reactor since the irradiation experiments revealed that the CIRENE fuel elements, after having accumulated a certain burn-up at low capacity, could be subjected only to limited capacity increases without running the risk of defects. To counteract the causes of these ruptures, which can be attributed to interactions of a mechanical type or to stress-corrosion phenomena, we developed graphite coatings either on the pellets or inside the sheath (Figure 17) and coatings of siloxanes inside the sheaths.

The irradiation experiments conducted on elements, adopting the three types of coatings, currently in the completion phase, demonstrate the validity of the previously selected solutions.

All of the results achieved during the irradiation experiments conducted step by step facilitated a continuous development of the starting specifications up to the time of the freeze put on the element project recently.

The work done is expressed in the form of 12 detailed specifications (bundle, bar, pellets, sheaths, plugs, grilles, UO_2 powder, pipes, round bars, sheet metal, Mo disc, Be powder) which, together with the element designs, constitute the essence of the knowhow which the CNEN has acquired in the course of the CIRENE element planning and production effort.

As part of the development of fuel cycle technologies, the IFEC recently undertook a new effort which is aimed at solving the following technical problems:

1. Construction of UO_2 conversion plan, using the sol-gel process, involving recyclable waste, for a capacity of 10 kg/day of natural U.

2. Treatment of liquid waste coming from:

a. The nitrohydrofluoric acid pickling of zircalloy;

b. The sol-gel conversion process.

Regarding waste under (b), a prototype plant was put up for treatment, using a thermochemical process based on the employment of lime.

Concerning waste under (a), a plant was planned and is currently being built, to be capable of treating 140 liters per day of waste, converting the waste, on the one hand, into solid waste and, on the other hand, into a recovery salt which is calcium nitrate.

Parallel to this, research was started on a continuous laboratory plant for the parametric study of the biological denitrification process for the purpose of evaluation its effective applicability not only to waste of type (a) but also waste of type (b).

PHOTO CAPTIONS

Figure 2. MTR element production line, fusion furnace.

Figure 3. (Top). Finished MTR element group.

Figure 4. (On opposite page). CIRENE production line, double-action mechanical presses.

Figure 5. Natural UO_2 element production line (CIRENE); view of continuous sintering subsection.

Figure 6. Natural UO_2 element production line (CIRENE); view of sintering subsection.

Figure 7. Natural UO_2 ceramics line, bar production subsection; welding and resistance (MFW) of plugs to sheaths.

Figure 8. (Left). Natural UO_2 element production (CIRENE). Equipment for drying the pellets, remote insertion into the sheath and welding of TIG of terminals.

Figure 9. (Below). Automatic equipment for finishing and profile turning of plugs after resistance welding (MFW).

Figure 10. Natural UO_2 element production line (CIRENE); equipment for assembly of bundles.

Figure 11. (Right). One of the equipment units for the dimensional inspection of bundles; control of profiles by means of image projection.

Figure 12. (Opposite page). Natural UO_2 ceramic line (CIRENE); beryllium laboratory, metallizer.

Figure 13. (Left). Natural UO_2 ceramic line (CIRENE); detail of operation involved in brazing the spacers on the sheath.

Figure 14. (Below). Checks and analyses, determination of carbon in materials.

Figure 15. Checks and analyses, determination of mechanical characteristics of materials.

Figure 16. Checks and analyses, control of enrichment of UO_2 in small bars.

Figure 17. Checks and analyses, visual dimensional controls on pellets.

5058
CSO:8128/1331-B

ITALY

DEVELOPMENT OF EUREX INSTALLATION TRACED

Rome NOTIZIARIO COMITATO NAZIONALE PER L'ENERGIA NUCLEARE in Italian Apr 81 pp 42-56

[Text] In the nuclear fuel cycle, the reprocessing of irradiated elements constitutes a necessary step on the way to the efficient utilization of uranium resources on whose availability the possibility of producing energy from nuclear sources depends.

A country that intends to use nuclear energy must therefore acquire the reprocessing technology and be able to bring it to industrial maturity. This is the motive that persuaded the CNEN [National Nuclear Energy Commission] to institute the EUREX Program, assigning it the mission of experimenting not only with new processes for the separation of uranium and plutonium from the fission products and on process equipment and control instrumentation on a scale that would permit the application of the results to the optimization of the undertaking of putting up a plant of industrial dimensions.

The first research work in the field of irradiated fuels reprocessing was started by the CNEN in 1959, while a team of researchers was organized in the CNEN laboratories with the assignment of conducting basic research and research of a technological type; it was decided to participate directly in the planning and construction of the reprocessing plant of the EUROCHEMIC Company at Mol, Belgium, financed by the OECD countries. It became evident rather soon that, to carry out a complete research program, helpful in furnishing all knowledge necessary for the planning and construction of industrial reprocessing plants, it would be necessary to put up a pilot plant of adequate dimensions from whose operation most of the necessary data would be obtained.

When this requirement was recognized, in 1961, it was decided to start planning a pilot reprocessing plant which was called the "EUREX Plant."

The concept study of the plant was fundamentally set up according to the following criteria:

Advisability of putting up a plant capable of reprocessing the MTR fuel elements from the European test reactors since at that time there was as yet no such plant in continental Europe;

Need to put up a sufficiently flexible plant, that is to say, a plant that could be adapted for experimentation with methods for the reprocessing fuels irradiated in the power reactors.

As a logical consequence of the adoption of this basic criterion, the following research and planning steps where then taken:

Laboratory-scale experimentation on chemical process designed for the reprocessing of MTR-type fuels;

General and detailed planning of a pilot plant capable of performing the above-mentioned chemical process and at the same time easily adaptable to chemical processes designed for the reprocessing of fuel elements coming from the power reactors;

Mechanical planning of plant's essential components, construction of scale models of said components, experimentation with models, and finally correction of blueprints on the basis of experimental results.

The completion of these activities, toward the end of 1964, was followed by the complete definition and the preliminary testing both of the chemical process for the reprocessing of MTR elements and for the individual equipment items.

In December 1964, the CNEN entered into an agreement with EURATOM by virtue of which the latter participated financially in the plant's construction and in the results achieved in the plant's operation. Competitive bidding was started in 1965 among the most qualified Italian industrial establishments for the construction of the EUREX plant. The bid was won by the BPD Company (now merged with the SNIA-VISCOSA), which has been joined by the Planning SNAM [National Gas Pipeline Company] of the ENI [National Hydrocarbons Agency] group.

The plant's construction was begun at the end of 1965 and was completed in March 1968. This was followed by inspection based on the contract and by the cold-operating tests.

After having obtained authorization for operation with irradiated fuel from Italian control agencies and from EURATOM, the cold operation of the plant was started on 19 October 1970 with a reprocessing run for elements of the MTR type which continued until the middle of 1974.

The reprocessing situation underwent profound development between the moment the construction of the EUREX Plant was started and today.

At the beginning of the seventies, the reprocessing technology was considered sufficiently proven for direct use in industrial plants of a commercial nature while the reprocessing capacities existing in Europe were greater than the needs. Under these conditions, European countries with industrial-scale reprocessing plants (Great Britain and France) together with the FRG (which offered ample market prospects) established United Processors GbmH [Incorporated] (URG) with the declared purpose of "rationalizing" the European market in this field and offering a commercial service to the other nations.

The situation changed profoundly during the seventies.

Negative experiences both in Europe and the United States, evidenced the need for resuming intensive research and development work on the level of industrial pilot plants in order to adapt the reprocessing technology to fuels from power reactors with heavy irradiation (burn-up) and to meet the strictest safety and protection standards.

Besides, the reprocessing problem assumed significance other than economic, in other words, also strategic and political, so as to render the possibility of a solution on the purely commercial level at least problematical.

All of this fully confirmed the validity of the program objective assumed by the CNEN since the start of activities in this field, that is, to pursue a development effort which would be as autonomous as possible regarding the reprocessing technology in Italy through the use of the EUREX Plant, in particular.

During the plant's construction, modifications were already made which permitted reprocessing not only of MTR-type fuel but also significant quantities of fuels discharged from power reactors. In particular we might mention the installation, down-line in the chemical process, of a machine for cutting such elements (mechanical treatment).

At the end of the MTR-type fuel reprocessing run (whose results are described below), the entire plant section dealing with mechanical treatment was completed and rendered more functional through the installation of a cell for the remote handling of the machine itself and for the evacuation of the solid dissolution residues.

At the same time, other plant sections were put in, along with various modifications and improvements suggested by the operational experience acquired through the reprocessing of MTR-type fuels; this was done to raise the plant's technological and safety level.

At the end of this series of efforts aimed at expansion, modifications, and improvements, the EUREX Plant was started up again cold in October 1980 with the reprocessing of a portion of the oxide fuel of the CANDU type, as described.

At the end of the CANDU run, starting in 1981, the expansion necessary for the reprocessing of LWR fuels was to be implemented in the EUREX Plant.

This expansion essentially consisted of the installation of a new extraction cycle in the two reserve cells, which were empty and which existed in the plant, plus a storage section for the final purification of the plutonium.

Description of Plant

The EUREX irradiated fuel element reprocessing plant was designed as an autonomous unit with the features of a semi-industrial pilot plant. It was organized in various areas with a series of buildings interconnected among each other according to the functional requirements.

The following are also located at the EUREX site: the environmental and radiation toxicology analysis laboratory, a technological room for cold component testing, the general store, and workshop and administration buildings.

Main Process Building

The center of the main building consists, on the ground floor, of a monolithic reinforced concrete block containing the process cells, with instruments and equipment for the following:

The dissolution of the irradiated fuel elements;

The adjustment and settling of the dissolution product;

Extraction and reextraction of the valuable material;

Treatment of waste gases;

Concentration of medium-radioactivity and low-radioactivity liquid waste;

Regeneration of solvent.

The block of cells is surrounded on three sides by hot tunnels under whose pavement run the cell ventilation pipes.

Located in the tunnels we have most of the pipes for the waste gas for supplying the transfer instrumental control means for the process (levels, etc.) with the pertinent valves and sensitive elements.

From the tunnels one can also reach, for maintenance purposes, some delicate parts of the equipment (valves and remote heads of dosimetric pumps for active currents), housed in cabinets recessed into the cement wall and screened toward the corridor with lead-filled steel doors.

On the same level, parallel to the tunnels, we also have the following:

On the north side, a cell for the processing of waste gases containing traps for removing halogens, particularly iodine, plus the finished-product store and the pump area for the fire-fighting system;

On the east side, we have the workshop building;

On the south side, we have the electrical systems and the air conditioning and air supply system for the operations areas and the laboratories.

On the upper level, at a height of 5.10 m above the cell block, we have the action zone which is equipped with two rolling handling bridges for the movement of the plugs that screen the cell closures.

At the ends of this area we have the following:

The cell for the concentration and intermediate storage of the finished product;

The complex for the mechanical processing fuel elements for power reactors, consisting of the cutting machine and two superposed screened cells (Figure 18); this complex is placed above the dissolution cell.

The following were put up parallel to the development plan pursued for the action zone:

(a) On the north side, the zone intended for the analytical control of the process which is divided into two areas, the highly radioactive area and the medium-low radioactive area.

In the former we have four hot cells (Figure 19) with biological protection in the form of cement with a thickness of 1.20 m and equipment with handling devices.

The area of each cell is 1.80 m x 2.20 m. Along the sides of the four cells (Figure 20), two sampling stations were set up; they are screened with 25-cm lead bricks and they are equipped with mechanical pincers.

The medium-low radioactivity area comprises seven laboratories.

In the two laboratories equipped for process analysis we have another two sampling stations which are not screened.

In the other five laboratories, technicians perform special analyses on the finished product, mass spectrometry, preparation of quality control standards, and the α, β, and γ counts as well as the cold analyses. These laboratories are equipped with 20 glove boxes and with instrumentation to perform the required analyses;

(b) On the south side, the area set aside for the control of the process itself which comprises the cold reagents supply room (Figure 21) and the control room (Figure 22).

Storage Basin

At the west end of the process building, through passageways protected by double doors, we have the element storage area (Figures 23 and 24).

The storage basin has a surface of 13.5 m x 10.5 m and a depth of 6 m in the storage zone and 7.5 m in the transport container receiving zone.

Corresponding to the reception basin we have, on the south side, two tanks for the decontamination of the transport containers and the movable platform for the irradiated fuel transport equipment.

This zone is served by a 40-t moving crane while the movement of fuel elements into the storage pool is handled with a 1-t block and tackle mounted on a mobile overhead crane.

The annex to the storage basin building, on the north side, contains a circuit for the cooling and filtration of the water and a resin plant for purification.

Laboratories and Workshops

The main process building and the deposit basin are accessible through the "cold" and "hot" locker rooms situated at a height of 5.10 m in the transversal building, on the east side, which, in addition to the workshops, houses the laboratories of the analytical area and of physical health and the "hot" infirmary which is particularly equipped to render aid to persons in case of contamination.

On the ground floor we have an electronic center for the collection and automatic processing of analytical and process data.

Radioactive Liquid Waste Storage

The liquid waste deposit facility consists of three concrete cells built at an elevation of 171.20 m above sea level (cell floor) and a cell at an elevation of 171.20 m above sea level. The zero level of the plant is at an elevation of 171.50 m above sea level.

Two cells contain two pairs of reservoirs, each, for the medium radioactive water waste and for the organic exhaust; the third contains a pair of reservoirs not yet placed in operation, representing a potential reserve for medium radioactivity waste.

The fourth cell, on the upper level, is subdivided, with separation walls that are 2 m high, into five compartments, containing one reservoir with a capacity of 50 m^3 (useful volume) for the storage of highly radioactive watery waste.

The lines for the transfer of liquid waste from the process building and the reservoirs run in a buried underground passage, on two level, 90 m long, the lower one for highly radioactive waste and the upper one for the other waste.

Safety Aspects and Health Protection

The handling of radioactive and/or fissile material in major quantities, in the solid, liquid, and gaseous state, at various temperatures and in the presence of aggressive and corrosive flammable reagents, in a reprocessing plant, for safe containment of such material, requires conceptual, design, and management decisions and solutions of a particular type, capable of coping not only with the risks deriving under normal conditions but also and above all in accident situations which could arise in connection with various unusual internal and/or external events.

The tremendous development in safety considerations in the recent decade in terms of standards, as far as EUREX is concerned, introduced the need for making some followup adjustments on the basis of tests conducted with more advanced criteria when compared to those used at the time the plant was being designed and built.

Site

To determine the limits of receptivity of the site and the surrounding areas and the environmental impact of the plant, an in-depth study was made in 1970-1971; it covered radiation ecology, hydrologic, meteorological, geological, and population aspects.

This study made it possible to identify the "load ceiling" for the Saluggia site and the groups of individual radioisotopes which might possibly be released outside the plant. The performance of the plant structures in case of earthquakes was reexamined in detail. It should be noted that, during the blueprint phase for the plant, this event was not taken into consideration since the site, according to the methodology commonly used in Italy, is considered not to be subject to any earthquake risk.

Through models developed more recently it was possible to extrapolate for the EUREX site a reference earthquake with an acceleration, on the ground, of 0.13 g, on the 1971 Newmark spectrum, with attenuation of 5 percent. The theoretical verification of the structures showed that they will resist an earthquake of that proportion; this does not include some portions which are not relevant for purposes of safety and the static containment of the plant therefore remains assured.

Another event considered is the possible flooding of the EUREX site due to a flood on the Dora Baltea River.

Extensive statistical investigations in the basins of the main river and its tributaries and theoretical evaluations based on probability until 1972 have placed the safe reference elevation--in case of a flood along the Dora Baltea River near the EUREX site--at 173.5 m above sea level.

On the basis of these conclusions, a blueprint was prepared for a complex of defensive works designed to protect the EUREX site from unusual water events.

These projects, completed between 1975 and 1977, include the following:

Presumption of impermeabilization around the process building and the ventilation zone and its elevation up to a level of 173.50 m;

Construction of a new health service building on the basis of earthquake criteria and at an elevation 173.50 m;

Construction of a yard area on an elevation of 173.50 m for the connection between the plant and the new auxiliary service building;

Construction, on the same elevation, of the solid waste deposit shed.

Static Containment

All processing equipment installed in the cells is welded and built with special low-carbon-content steels, such as AISI 304 L, AISI 316 L and EPE 21, with thicknesses varying between 4.5 and 12 mm, depending upon the nature and temperature of the solutions contained.

They constitute the first barrier of the static containment.

In a direct handling plant, such as EUREX, it is designed to retain its integrity for the entire lifetime of the plant.

Particularly strict construction specifications were therefore adopted for inspection of materials, for the procedures to be used, and the operators. In general, the ASTM and UNI codes were used; however, supplementary tests were prescribed for the welding problems.

The metallographic examinations, the analyses of the storage area, and the corrosion tests were particularly carefully performed.

Various intermediate inspections were required during the entire process. Among the most important ones we might mention the following:

Checks of heat treatment involving cold-shaped parts with major deformation and on all hot-shaped parts;

Use of penetrating liquids in checking on all shaped parts;

Use of penetrating liquids in checking on forged parts and worked parts with special tools after complete processing;

Use of penetrating liquids to check all welding joints;

Special tests on special parts so as to reveal any irregularities in welding operations;

These tests were conducted particularly carefully regarding the welding of pipes to the pipe plates where numerous tests, both mechanical and metallographic, were performed. For these cases, selective metallographic attacks and examinations with electronic microprobes as well as analysis through x-ray diffraction were also requested;

Systematic checks on materials deposited, both from the chemical and from the metallographic viewpoints;

In special cases, ultrasound tests were sometimes requested.

Regarding the final inspections, the main checks requested were as follows:

Radiographic checks on all weldings;

Final check, using penetrating liquids, on welding joints and adjacent areas;

Hydraulic tests;

Tests with helium (needed only for highly radioactive tanks and pipes).

The cells themselves and the transfer tunnel act as a second barrier for the static containment. In this connection, the cells were coated along the bottom and the walls up to a height of 30 cm with a 3-mm sheet of AISI 304 L and they are provided with little recesses equipped with alarm devices to indicate the presence of liquid as well as emptying means.

Periodic tests for the washing of the cell floors permit the identification of even small leaks of radioactive material from the equipment and at the same time help in checking on the integrity of the lining and the civil engineering part underneath, which was executed with particular care due to the presence of a high phreatic fault.

Glass fiber fabrics were used for impermeabilization, with aluminum sheets placed in between.

Above the impermeabilization, layers of concrete were placed, sufficient to reduce the intensity of doses so as to assure the good resistance of the tar substances put down hot between the various impermeabilization layers.

The casting for the concrete at the floor of the cells and the walls were executed with particular care. Both elements were cast continuously so as to prevent any dangerous repeat castings.

Joints were inserted between the castings and the walls either in inoxydable steel or in neoprene or in PVC, depending upon the intensity of the doses to which they would be exposed.

Dynamic Containment

The plant's ventilation system was so designed as to create a cascade of depressions growing from the outside toward zones with ever greater contamination risks.

Under normal conditions, the formation of radioactive aerosols is restricted exclusively to the inside of the tanks and the processing equipment where the air used for the bubbling pipes of the pneumatic instruments, for the homogenization and sampling systems, and for the transfer equipment, comes into direct contact with radioactive substances.

All of the equipment is hermetically sealed toward the rest of the plant and is ventilated separately and it is called the "primary dynamic containment."

It is subdivided for operational reasons into branches which are more or less independent of each other. However all flow together into the general ventilation system, called the "secondary dynamic containment" up-line from the absolute filter barrier.

The discharge gases coming from the primary circuit represent about 1 percent of all of the air discharged through the central chimney.

They are subjected to a series of treatments primarily for the purpose of drastically reducing the quantity of active [radioactive] aerosols before the absolute filter barrier.

The general filtration plant, with expulsion, has a capacity of about 50,000 m^3/hr and is equipped with prefilter and absolute filter groups.

The air is extracted from the plant with the help of two fans, one of which is in reserve for the other one, and it is then released into the atmosphere at a height of 60 m.

The entire ventilation system, up to the housings of the absolute filters, is made of AISI 304 L or AISI 304 inoxydable steel.

The efficiency of the filtering system is continuously watched and periodically checked through the following:

Measurements of charge losses of primary filters and absolute filters;

Monitoring, recorded around the clock, of the expelled air, for alpha and beta-gamma particles, for halogens (I^{131}), and for noble gases (Kr^{85}).

Periodic measurement of efficiency of primary filters and primary filter plus absolute filter system;

Disclosure of radiation dose accumulated on filters with probes placed in gamma screen.

The boundary values are established by the safety and health protection authorities and when any of those values are reached, the filters must be changed.

Control System

Nuclear Instruments

Nuclear instruments for physical surveillance of personnel and environment consist of the following:

A monitoring and gamma radiation alarm system in the controlled work area, equipped with ionization chamber detectors with measurement field from 0.1 to 10,000 mR/hr;

A detection and alarm system for critical leaks located in the hot tunnels around the process cells, equipped with detectors only for gamma rays since the thickness of the cell walls acts as a total screen for the neutrons generated inside;

Continuous air sampling and filtration device in the individual work stations with periodic measurements of accumulated fine dust to check on contamination;

System for continuous monitoring of air discharge into the chimney; a portion of air sampled at a height of about 1/3 up along the chimney is aspirated through a filter nozzle on which is placed a scintillation counter for alpha and beta-gamma monitoring.

The air successively goes through two chambers, both of which are equipped with scintillation counters, for measurements of crypton 85 (noble gas) and iodine 131, respectively. The process cells containing organic solutions and the analytical laboratories are equipped with CO_2 fire fighting devices.

The detection system in the cells, that is to say, the system of sensitive elements responds to a light intensity of about 0.06 lux and at the same time is insensitive and resistant to an even highly intensive gamma radiation field.

Every cell is equipped with several sensor elements, connected two-by-two, so as to prevent false alarms.

Anaytical Process Control

The process currents are subjected frequently to sampling and analysis, both to check on the progress of the process itself (concentration of nuclear materials, radioactivity levels, etc.) and to check on the distribution of fissile materials in the individual areas of the plant in order to prevent and/or avoid the development of threats to nuclear safety and health protection.

Amply proven and tested analytical systems and instruments are used, such as recording potentiometers, spectrophotometers, pH-meters, and for safety checks there are coulombmeters, polarographs, spectrophotometers, atomic absorption, and mass spectrometers.

A part of this instrumentation has been modified so as to adapt to its use inside the glove boxes and the hot cells (Figures 33, 34). For analyses of alpha, beta, and gamma emitters, we use Ge(LI) and pure Ge detectors, with surface barriers, with zinc sulfide and sodium iodide, connected with multichannel analyzers (4,000, 1,000, and 400 channels) and single-channel chains. A portion of the instrumentation described is connected directly to the IBM S/7 computer for automatic processing of analysis of data. On some lines in the plant however some instruments for direct "on-line" analysis have been installed.

Instrumental Process Control

To achieve a high degree of reliability and simplicity in installation in the "hot" part, the process control and regulation instrumentation and the static and dynamic containment is essentially of the pneumatic type.

Precisions of ±1 percent can be obtained from the instrument chain.

The use of high-precision sampling instruments, which can be inserted parallel, facilitates a precision of 0.22 percent during the tank calibration phase or for the measurement of the volumes pertaining to nuclear accounting.

The electrical plants, where aboslutely necessary inside the process cells, such as, for example, for the agitators, is made airtight [water tight] with the help of materials which have now been extensively tested in high-intensity dosage environments. The movement of solutions in the cells takes place essentially through air or steam ejector hoists, thus avoiding mechanical parts, moving in inaccessible areas, as much as possible. The compressed air, the steam, and the moving force come from the general support station. Round-the-clock service is provided by the three steam generators of 2,500 kg/hr, each, and 4 air compressors of 500 m^3/hr, each, of which, respectively, one and two are always operating, while the others are in reserve.

In the absence of supplies from the ENEL [National Electric Power Agency] grid, electric power is supplied by two emergency diesel electric power generating groups, one in reserve for the other one, each with 900 kva.

Operating Experience

Start of Operations at Plant, MTR Runs

After the unit tests and the reference tests with unirradiated depleted U, performed during the first 9 months of 1970, the plant was started hot on 19 October 1970. During the first phase of the hot run, limited to one year, 112 MTR elements were reprocessed, containing about 21 kg of highly enriched U coming from the Ispra 1 reactor, using a TCA (tertiary amine) in solution [as published] for the recovery and purification of uranium.

Hot operations were interrupted in 1971 for a review of the safety criteria adopted in the plant project.

The plant was then started up again in February 1973 with an alternate chemical blow-sheet, based on the recovery of enriched uranium with TBP in dodecane.

Using this scheme, between February 1973 and June 1974, 394 MTR elements were processed, equal to about 90 kg of U, including 30 kg of material enriched to 20 percent.

The 506 elements constituted the total irradiated fuel discharged until then from the Ispra I (EURATOM), Avogadro (SORIN) and G. Galilei (CAMEN) research reactors. The element cooling time varied between 2 and 10 years.

The quantity of fission was equivalent to about 250,000 Ci.

Restarting the Plant, CANDU Run

Upon completion of the MTR runs, the plant was closed down and major expansion and modification work was done in the plant itself and at the site starting in 1975 for the purpose of adaptation to the more modern safety requirements described previously. At the same time, authorization was given to restart the plant hot with the CANDU run. After that, the plant was started up again hot on 8 October 1980, the date of the start of the CANDU run which is supposed to end in December 1981.

This run consists in the reprocessing--as part of the CNEN-ENEL-AECL cooperation agreement--of CANDU-type fuel elements irradiated in the reactor at Pickering, Ontario, Canada, at about 9,000 Mwd/t, to check an original chemical scheme worked out by AECL and CNEN for the recovery of Pu alone, using aminic solvent.

Lessons Learned during MTR Run

The recovery of U was more than 98 percent with TBP, whereas, with TCA, the losses were greater because of the prolonged operations in the final setup of the chemical scheme especially regarding the final purification of uranium to remove alpha impurities due to transuranic (plutonium and neptunium).

With the TCA process, the finished product specification limits (15,000 alpha disintegrations per minute and per gram) was obtained with the help of supplementary treatment with HX 70 (hydroxamic acid soluble in the organic phase), a special extractor for these products developed in the laboratories of the Casaccia CBN.

With TBP, on the other hand, it sufficied to have a simple transition in the two extraction cycles to obtain uranium with the desired purity. TCA demonstrated on the other hand that, compared to TBP, it has a greater capacity to separate the uranium from the fission products with the exception of Ru, as we can see in Table I which shows the average decontamination factors obtained.

Table II shows the values for the residual impurities measured in four batches of finished products.

More than 99.9 percent of the fission products remained in the highly radioactive refined products, called 1AW, which were stored in the proper reservoirs, pending future processing. All other water currents in the process, after concentration treatment in the plant, are temporarily stored as medium radioactive wastes, awaiting subsequent processing in bitumen.

Table III shows the volumes of liquid waste produced during the MTR runs and stored at the EUREX site. After a second evaporation, the distillate is collected along with the condensed materials and the cooling water in two release tanks of 1,000 m^3, each, and it is then discharged, after monitoring, into the Dora Baltea River.

The total volume of liquid waste dumped into the Dora Baltea River was 180,000 m^3, remaining fully within the limits established for environmental protection, that is to say, within several percent of the area's receptiveness, as determined. Even more marginal was the environmental impact deriving from the air-like discharges coming from ventilation (air volume equal to about 440 million m^3 per year) whose radioisotope content is being watched and checked continuously.

The total release of Kr^{85} was 11,500 Ci during a period of 3 years, corresponding to just a few percent of the maximum discharge permitted into the air for this radionuclide. The reliability of measurements at the release points was checked by controls on the environmental radioactivity levels performed within a radius of several kilometers around the plant, on a variety of materials and samples.

During the reprocessing runs there were never any abnormal situations, neither during routine operation, nor during maintenance or special actions involving radioactive sections or areas of the plant as a whole.

The most important maintenance and modification operations in hot areas of the plant were as follows: decontamination and dismantling of the cutting machine and its modification to install the hydraulic cylinders outside the cell; substitution of the rotation mechanism for the rotars [flywheels] in the batteries of mixer-decanters; replacement of iodine washing columns with silver-coated branches through the installation of silver-coated zeolith columns; improvements in "vessel vent" filtration system of tanks for the storage of highly radioactive liquid waste; modification of finished product cell to permit installation of larger-volume storage reservoirs; replacement of alpha-contaminated equipment in hot cells of plant's analytical laboratory.

The individual exposure level was maintained for all personnel below 10 percent of the average dose which personnel exposed to radiological risks by virtue of their jobs may accumulate by law.

Analytical and Safeguard Checks

To check on the conditions of the chemical process and its correct functioning in the individual sets and to ascertain the flow of fissile material for nuclear safety reasons, almost 20,000 analytical determinations were made on about 700 samples inserted for quality control, parallel to the plant's operation as such.

The types of analyses varied from the simple determination of the density or acidity to a determination of the isotope composition or the traces of impurity in the finished products.

Analyses of the same type, performed on batches of the final product by the business partner, during the shipment of the material, fully remained within the results of EUREX and confirmed the high quality level achieved by the plant's analytical laboratory.

The degree of analytical measurement estimation is particularly significant in case of the determination of the movement of fissile material for purposes of nuclear accounting. In addition to continuous checking on the quality of methods and analyses (performed by other laboratories on individual samples), two types of material reviews were conducted. In the first one, the quantity of fissile material measured at the threshold of the process in the plant is compared to the quantity calculated on the basis of the manufacturing and irradiation data from 506 elements reprocessed.

Anticipated Research and Development Activities

On the basis of the guidelines for the IV Five-Year Plan of the CNEN for the period of 1980-1984, a coordinated complex of research efforts was worked out within the context of the program objectives of the fuel cycle department; these research efforts involve the "reprocessing" line centering on the use of the EUREX and ITREC reprocessing pilot plants and the Casaccia reprocessing research laboratory of the CSN.

As far as the EUREX plant is concerned, it is generally expected that it will be used as an industrial pilot plant for reprocessing experimentation with fuels from power reactors with growing irradiation.

It is quite well known that recent negative experiences in various countries pointed to the need for further study of the problems involved in technical and safety processes on the laboratory and pilot plant level, connected with the application of the EUREX process for the retreatment of heavily irradiated fuels. This knowledge is indispensable in order to be able adequately to put together an industrial reprocessing plant.

By virtue of its characteristics, [illegible] REX plant is particularly suited for this type of experimentation.

The adaptation of the plant for the reprocessing of fuels for power reactors, which was mentioned earlier, was studied and planned with that view in mind.

Specifically, the activity program for the EUREX plant provides for the following:

Reprocessing of limited but significant batches of LWR fuels, irradiated in the Italian power plants, for the separation of uranium and plutonium by means of a Purex-type chemical process, possibly modified.

So far, 52 cross-shaped elements, irradiated in the Trino Vercellese Power Plant, with a high combustion rate, have already been stored near the EUREX storage basin;

Possible reprocessing of fuels with highly enriched uranium, of the MTR type, irradiated in Italian or European research reactors, if and to the extent that this service can be requested.

As far as the treatment and processing of radioactive wastes are concerned, the program objective assigned to the EUREX plant is to come up with an assembly of plants and activities which, while guaranteeing correct management of waste produced in the plant itself, will facilitate the acquisition of an integrated body of knowledge and experience which can also be used on the industrial level, in a second phase. The construction of a plant for the treatment and processing of medium and low radioactivity waste, through the inclusion of bitumen and/or polyester resin, at the EUREX site, assumes particular importance. The blueprints for this plant are now ready and it is expected that the work can be started in 1981-1982.

To expand this plant, plans have already been made for a pilot plant for the vitrification of highly radioactive liquid waste, called IVEX, on the cold and hot process now being developed by the laboratories and plants of the COMB departments.

PHOTO CAPTIONS

Figure 18. High radioactivity laboraties, analytical cells.

Figure 19. Sampling cells.

Figure 20. Medium radioactivity laboratory with glove boxes.

Figure 21. Cold reagent supply room.

Figure 22. View of control room.

Figure 23. View of deposit basin for irradiated fuel elements.

Figure 24. Detailed view of deposit basin for irradiated fuel elements.

Figure 25. View of EUREX plant laboratories.

TABLE CAPTIONS

Table I. Initial Radioactivity and Decontamination Factors during First MTR-Type Fuel Extraction Cycle
Key: 1--Fission products; 2--TCA run; 3--TBP run; 4--Maximum radioactivity, Ci/gU (supply).

Table II. Restored Finished-Product Batches
Key: 1--Number of bottles; 2--Liters; 3--Traces; (*) After treatment with HX.

Table III. Liquid Waste Stored at EUREX Site
Key: 1--Highly radioactive waste; 2--Medium radioactive waste; 3--Organic waste.

Table IV. Fissile Material Input Measurements
Key: 1--Enrichment; 2--Reactor calculations; 3--EUREX measurements; 4--Difference.

5058
CSO:8128/1331-C

NUCLEAR-ACCIDENT PROTECTION RULES ISSUED

Stockholm DAGENS NYHETER in Swedish 1 Jul 81 p 12

[Article by Marianne Cecilgard: "New Rules for Nuclear Energy Protection"]

[Text] As of Wednesday, new safety rules will be in effect in event of accidents in nuclear installations.

Alarms shall be given by telephone and sirens in a central alarm zone within 5 to 10 kilometers of the nuclear power plant in Forsmark and in sectors in other parts of the inner preparedness zone 12-15 kilometers from the nuclear plant.

This was reported by the Uppsala provincial council on Tuesday. Installation of the alarm equipment is to start immediately. The Telecommunications Administration estimates it will be completed no later than December, 1982.

In November and December iodine tablets will be distributed along with an information brochure in the inner preparedness zone. "We will distribute tablets to 2,700 families and vacation houses, and we shall maintain a reserve of about 30,000 iodine tablets. Tablets will also be available at all pharmacies up to a distance of 50 kilometers from the nuclear power plant," says Lennart Osterberg.

The provincial council has the authority to act with no leakage having taken place. Fear of an accident suffices.

Municipal Plans

Municipal authorities are obliged to participate in preparedness planning. In addition, they are to contribute personnel and materiel for measuring radiation and provide involved personnel with training and have it participate in exercises.

Obligations ofcounty authorities extend beyond county borders. This is new.

A change in instructions for the State Radiation Protection Institute, SSI, calls for the Institute to coordinate preparedness planning and serve as advisor to the county authorities.

The Inner Zone

The edict on protective measures in the event of accidents in nuclear installations is new. In it, the Government has determined that the inner preparedness zone shall be at a distance of 12-15 kilometers, and the radiation measuring zone 50 kilometers from the nuclear plant.

Complete planning of preparedness measures is now to be undertaken in the inner preparedness zone. Present planning involves only areas at a distance of 10 kilometers from the nuclear installation. The government has set aside 16.7 million kronor for these measures for the 1981-82 budget.

11,256
CSO: 5100/2281 END

END OF

FICHE

DATE FILMED

31 JULY 1981